metre of ice thickness per annum. It is singular that an increase in the southern ice-cap tends to increase that of the northern also, by lowering the level of the ocean, and so retarding circulation. Any cause which lessened the Antarctic ice-cap would moderate the rigour of the extreme northern climate, and tend to warm the Arctic Ocean.

So much for the first half of the book under review. The remaining half will be treated in another article.

OLIVER J. LODGE.

ELEMENTARY METEOROLOGY.

Elementary Meteorology. By William Morris Davis, Professor of Physical Geography in Harvard College. (Boston, U.S.A.: Ginn and Co., 1894.)

THE necessity for the production of text-books would seem to diminish with lapse of time, but the examination of publishers' catalogues discloses no diminution in their numbers. If there be any excuse for the writing of new text-books in any branch of science, it might be found in those at present unformed departments, like meteorology, where well-directed and systematic inquiry is constantly enlarging the boundaries of knowledge by the addition of new facts, or the discovery of fresh grounds for the acceptance of facts not yet admitted as demonstrated truths. The science of meteorology is not like that of mathematics, which immediately displays its power, and has nothing to hope or fear from passing time; but appealing as it does to observation and experience, its progress must be gradual and comparative. And if any one be entitled to write text-books, it is those who having been engaged practically in teaching have felt a particular want to be ill-supplied, and who feel themselves qualified by their office and minute acquaintance with the subject to remedy the defect. For these reasons we may welcome the appearance of Prof. Davis' work on "Elementary Meteorology," which originally intended for those engaged in the earlier years of college study, and with whom the author has been brought much into contact, may well be read by others, who wish to keep themselves acquainted with the more recently-acquired facts concerning the behaviour and the processes of atmospheric circulation. In fact, Prof. Davis has had both classes of readers in his mind, as he has prepared this work; and further, recognising how many in his own country are more or less intimately connected with the national and state weather services, he has endeavoured to supply them with a well-digested treatise which may be a supplement to the meagre but precise instructions issued to observers under official authority.

It is not to a text-book of this character that one goes to learn the present position of the more speculative side of meteorology, and since the author excludes from his programme purely mathematical discussion, some of the more recondite inquiries cannot be treated. The qualities that we should look for in a book intended primarily for college students, are exactness of facts and expression, lucidity of description, and orderly consecutive arrangement, carrying the student gradually forward to complete knowledge of the subject, within the limits proposed by the author. And, supposing this to have been the aim of the writer, it seems to have been admirably fulfilled. A text-book embracing the views and the experience of others cannot hope to be original, but it should be thorough, and this on the whole is the opinion we have conceived of the book.

In a few short chapters, we have a description of the atmosphere as a whole, and of the forces that are continually operative, giving rise, by the succession of day and night and summer and winter, to vertical interchanging currents whose behaviour under varying conditions and circumstances embraces the whole province of meteorology. Having thus prepared the way by sufficient reference to the physical processes which influence the temperature of the earth as a whole, it might have been expected that the author would have proceeded naturally to the consideration of local temperatures, and a more minute division of his subject. But, unfortunately, he delays the progress by the introduction of a chapter on the colour of the sky. Doubtless the author can defend himself, but to us, it appears an interruption of the orderly development of the subject, and a defect in the arrangement of the work. It is, however, the only distinct blemish to which we shall have to refer in the plan and conception of the book. We should suspect that the subject of the colour of the sky has had great attraction for Prof. Davis, and that he has over-valued its importance in a book of this nature. But having surmounted that difficulty, there is nothing to stop the consideration of temperature, its measurement, its distribution, and the causes affecting its disturbance, either as a whole by the obliquity of the earth's axis, or locally as by ocean currents, &c. All this is very admirably arranged; and here we may say a word for the sufficiency and clearness of the diagrams. Prof. Davis has apparently had access to a very admirable and complete collection, and his selections are judicious and well illustrative of the points under discussion.

From isotherms the transition to isobars is easy and natural, and though we cannot expect anything original in the description of a barometer, the quality of thoroughness to which we have before alluded is again illustrated. The author does not recommend the correction of the individual readings of the barometer to the sea-level, a practice which is falling more and more into disuse. Unfortunately a definition of sea-level, as understood in America, is not given, at least where we expected to find it. We doubt whether many English readers could supply a correct definition, but the expression may be perfectly clear on the other side of the Atlantic.

Proceeding as far as possible with the discussion of barometric readings, revealing the varying distribution of pressures, the author finds it necessary to introduce the subject of the observation and distribution of the winds. This we consider absolutely in its right place, and assists the gradual progress materially. On the subject of the reduction of wind observations the information is certainly meagre. Wind observations offer one of the most complicated problems in meteorology, one certainly out of the range of the ordinary college student, and this may be a sufficient apology for the author. Here, too, we should have looked for some reference to the recent work of Prof. Langley, indicative of both the difficulty of making exact observations of velocity, and

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of the important results that may be expected from a complete discussion. But the author is more intent upon describing the general effects of wind circulation as affected by the rotation of the earth, before proceeding to partial and local disturbances. Of course, in this section, the author follows Ferrel, and without employing mathematical illustration, succeeds in fairly well placing before the student an outline of the essential features that mark the work of his distinguished countryman.

This gradual progress of the book seems to throw the question of rain and precipitation far into the work. No inconvenience arises from this, though in many minds, not necessarily scientific, the subject of rain is considered the most important fact in connection with meteorological science. Prof. Davis, however, is not to be hurried. He wishes to approach the subject of cyclones and local storms, and as these are more or less accompanied with rainfall, he finds it necessary, in pursuance of his scheme, to clear away the general features connected with the moisture of the atmosphere, including clouds, dew, frost, and the various forms in which we find water precipitated. In connection with cloud observation, a simple method is mentioned of determining the direction and velocity of cloud movement, which might be worthy of more systematic trial than, it is believed, has yet been accorded to it. The method consists in noting the path of the reflection of a cloud in a horizontal mirror, in which the observer looks through an eye-piece that remains fixed during the observation. If the eye-piece is placed so that the reflection of a certain part of the cloud falls at the centre of the mirror, and after a few seconds a radial arm is turned so as to bring its edge on the position then taken by the cloud, the edge of the arm will lie parallel to the cloud's motion, on the admissible assumption that the cloud is drifting in a horizontal plane. (pp. 181–2.) A slight addition to the apparatus permits the ready appreciation of the relative velocity of the cloud drift, far better than can be estimated by the eye alone.

Having dealt with the general subject of rain and clouds, the author is in a position to treat of cyclonic storms, thunderstorms and tornadoes, and the more violent interruptions of meteorological phenomena. The reason for this section, interesting as it is, being sandwiched in between the description of clouds, &c., and the causes and distribution of rainfall is, however, not so clear. The author probably did not wish to have a greater separation than possible between his chapter on winds and that on cyclones; but we think it would have been better to have finished the subject of rainfall before returning to the motion of the atmosphere. But the writer is clearing the way for the consideration of the "weather," "weather prediction," and climate, with which his book ends. On the subject of weather forecasts, Prof. Davis does not take a very hopeful view. We believe that our authorities at Victoria Street look with a certain degree of satisfaction on the results of their predictions. They are able to point to a percentage of some 90 per cent. of successes, and as far as is known, they, and the public too, consider their existence justified. But listen to Prof. Davis:—"The number of stations has grown, and their equipment has been materially improved; the accuracy of various processes preparatory to charting has been increased; a vast body of information has been accumulated for study relative to the kinds and changes of weather; various predicting officers have had extended practice in their art, and while the forecasts are truly made for longer periods than they were at first, and are certainly superior in definiteness and accuracy to those issued twenty years ago, their improvement is not so great as was hoped for. Mistakes in prediction are still made, and of much the same kind as at the beginning of the service." (p. 325.)

In laying aside this book, which we have read with pleasure, and heartily commend to the student, one word of caution may not be unnecessary to the English reader. The book is written for American students, and the use of "our" and "us" is apt to be a little confusing. For instance, "our" damp winter north-easters (p. 145) will scarcely apply to "our" climate, and the statement (p. 269) "that in the six years 1885–1890 there were 2233 buildings set on fire by lightning in this country," is one which must be considered in connection with the area of the country to which it applies.

W. E. P.

THE WEALDEN FLORA.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum. Part I. *Thallophyta—Pteridophyta.* By A. C. Seward, M.A., F.G.S. (London: Printed by order of the Trustees, 1894.)

THIS hand-book serves to show how interesting a monograph of all that is known regarding this mysterious formation would prove. In the folds of the Wealden we imagine the secret of the evolution of angiosperms must be locked. It is as if we stood at the mouth of a great river flowing from an unexplored interior, whose flotsam we anxiously interrogate for clues as to the nature of the unknown hinterland; yet nothing reaches us from beyond the coast-belt, which we have already explored. The Wealden flora is in fact so meagre that it is hard to regard the formation as fluviatile, and one is tempted to believe that it was formed in some brackish lake into which the spoils of the land were rarely drifted.

The first pages afford a comparison of the plants of the English Wealden with those of other countries, but that any of the formations included, especially from beyond Western Europe, are really contemporaneous, must be open to doubt. None of them, however, with trifling exceptions, contain any indications of the presence of angiosperms. Another remarkable fact is the extraordinary geographical range of the English species, only ten out of thirty being peculiar to this country, and these are the most poorly represented. A perhaps unavoidable drawback, to this book and former ones of the series, is that they change established nomenclature so greatly as to render preceding lists of British fossils useless.

A new term, *Algites*, designates the markings which probably represent Algæ. A rather widely distributed *Chara* and a new species under *Marchantites* are important acquisitions; as are the three species of *Equisetum* with tuberous roots, of which one is new. These tubers show that some description of fruit could have been preserved if they had ever been present.

The bulk of the volume is taken up with the Ferns, which are fairly, perhaps over-cautiously, treated. The

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